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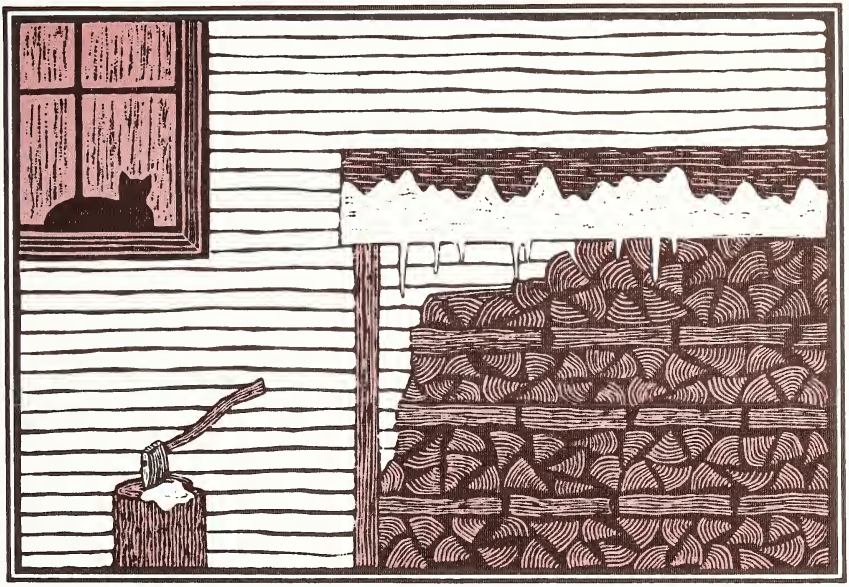

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July 1991

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So You're Thinking of Heating With Wood . . .

So are a lot of other Montanans. For some, wood heat is a joy. It assures them of warm rooms and equally warm feelings of self-reliance. They even relish the labor involved. For others, though, wood heat is a pain, both for themselves and for their neighbors. It pollutes the air and endangers their property (and their lives) by creating all sorts of fire hazards. They never manage to adapt their day-to-day habits to the demands of their stoves.

Your ability to adapt your life to suit your stove will determine whether you view wood heat as a joy or a pain. Keeping a stove is like keeping a horse. It takes time, labor, knowledge, and constant attention. You've got to know what happens when wood burns, how your particular stove tries to manage the process, and exactly what you must do to help it.

Be wary of your stove. We know at least one Montana newcomer, an expatriate Philadelphian, who admits that he was so delighted at the prospect of using his brand new stove that he stuffed it with wood the first time he fired it—it responded with enough heat to drive his family out of the house.

Know the ways of stoves before you buy one, and be absolutely sure that you really want to buy one. You might do better, in the long run, to invest in a little insulation and weatherstripping instead.

Conservation First

The owner of a drafty 19th-century house in Helena invested in both. He put a small wood stove in his first floor parlor but thoroughly insulated and weatherized his second floor bedrooms. Now, when the cold west wind blows, his second floor rooms are much more comfortable than they used to be, and more comfortable than his wood-heated but still drafty parlor. Those drafts are the culprits.

Another Montana home owner turned his third floor office from a barely habitable icebox of a room into the warmest place in the house, not by installing a stove, but by weatherizing. He gained a lot of comfort without touching the home's heating system and decided that a wood stove wasn't a necessity after all.

No matter what you burn for heat, you'll save money if you burn less, and you'll burn less if you'll weatherize your house. So insulate the place. Find out where you're losing heat and try to stop those leaks. Conserving your fuel is almost always cheaper, in the long run, than changing your fuel. But even if you're convinced that you're going to heat with wood, you'll benefit by first insulating and weatherstripping your home, since you'll probably need a smaller stove if your home is well insulated.

The Stages of Combustion

Burning wood is always in one of several stages, depending on the temperature of the wood at the time. At different stages water vapor is driven off, creosote may be formed, or gases may be released. Understanding how wood burns is the first step in understanding how to get the most out of your wood heating system.

Stage One: Driving off water vapor (below 535° F).

Wood that isn't dry won't burn cleanly. If your wood hasn't been cut, split, and stacked away from moisture in a well-ventilated place for six months or so, your stove will have to dry the wood for you. But that's not the stove's job. The best it can manage under such circumstances is a dirty, wasteful fire.

Water escapes from drying wood as vapor, but the energy needed to turn water into vapor (and it takes a lot; remember your high school chemistry?) is not available as heat. So, your wood can't heat your room or your stove. It can't even heat your firebox enough to ignite the other volatile products of combustion. They'll come off, unburned, as dirty smoke. And where there's smoke, there is air pollution and creosote by the ton. (Some

species of wood in Montana trees, ponderosa pine for example, tend to produce more pollution and creosote than others. But, regardless of species, the problem is always aggravated if the wood is not dry.)

So use dry wood, beginning with small kindling, and start off with a hot, fast, oxygen-rich fire. Open the intake for primary combustion air, and maintain it by gradually adding pieces of wood 4 to 5 inches in diameter. The trick at stage one is to reach a high temperature in the firebox as quickly as possible, so you and your stove will be ready for stage two.

Stage Two: Production and combustion of gases and vaporized liquids (535°F to 1,100°F).

The dancing yellow flames that come to mind when you think "wood fire" are gases and vaporized liquids flowing from the hot wood and igniting as they go. There are many of these volatile products of combustion. Many are nasty pollutants; some are known carcinogens. Most, fortunately, will ignite if the temperature is high enough (at least 525°F), and if plenty of oxygen is present.

As these vapors ignite, they break down and recombine with oxygen to make such relatively harmless gases as carbon dioxide and water vapor, and, in the process, they release great amounts of energy in the forms of light and heat (lots of heat. That's what you want, after all). These combustion products, in fact, account for much of the fuel value in your firewood.

If these products of combustion don't ignite (because the temperature is lower than 525°F or because there isn't enough oxygen in the firebox), they'll take that fuel value away in the form of more dirty smoke. Think of the smoke pouring out of your chimney as wasted fuel. That's exactly what it is. Whatever doesn't get out will condense in your flue as creosote or acids that may ignite later and take your chimney (or your whole house) with it.

So, if you're letting those products of combustion get away by keeping a dirty, smoky fire, you're doing three things that you really don't want to do:

1. You're wasting your wood (that smoke is unburned fuel, getting away, costing you money).
2. You're polluting the air; it looks bad, but it's also a health hazard. Wood smoke contains carcinogens and irritants.
3. You're coating your flue with creosote. That's costly in several ways: creosote is acidic and will corrode your flue, shortening its life; those deposits are costly to get rid of; and, most important, creosote increases your chances for a house or chimney fire.

The trick, obviously, is to burn those products of combustion in the stove, before they get away. That requires a firebox temperature high enough to ignite them in the first place, and enough oxygen to let them burn completely and continuously for as long as they're produced. A good stove is designed to achieve and maintain these two requirements, but it can't do its job if you don't cooperate.

You're not cooperating, for example, if you add a big load of fresh wood and then damp-down your fire to hold overnight. The fresh wood will cool the firebox while introducing a rich new source of gases and vaporized liquids, while the damping-down will eliminate much of the oxygen needed to burn those gases and vaporized liquids.

You're not cooperating if you burn in warm weather—say, around 40°F. To be comfortable with those outside temperatures, you're likely to find yourself constantly damping-down the fire, which will let more pollutants into the air than will a clean, hot-burning fire.

You cooperate with your stove when you maintain a hot, clean fire, which means keeping the air intake open and adding new wood in small amounts and at frequent intervals. That, in turn, means staying awake, staying home, and keeping an eye on your fire.

If you can't watch your wood stove, and it is to be your only source of heat, then resolve to accept a chilly house when you get up in the morning or come home from work. A wood stove simply cannot be used as if it were a gas furnace. You can't set it going, turn it down low, and then walk away (except with pellet stoves).

But there's a whole generation of Montanans out there who want to do just that, say fireman Bob Knudson and chimney sweep Mike Comola, who've seen plenty of stoves from the dirty end. Most of us have grown up spoiled by the carefree 24-hour-a-day warmth of gas and electric heat, and we're having a hard time adjusting to the demands that wood heating makes on our time and attention. We have to relearn what our grandparents and great-grandparents knew, and our mistakes will teach us if our good sense doesn't.

Stage Three: Combustion of charcoal (1,100°F cooling to the end of the fire).

Once the gases and volatile liquids have been driven out of the wood and burned, there remain the black coals, or embers, of charcoal. They consist mostly of carbon (the same element that coal and barbeque briquets are made of), and this carbon will continue to glow (burn) for a long time, releasing a great amount of heat.

Although little visible smoke or creosote is produced at this stage of combustion, a good supply of air is still needed to hold down the production of such secondary products as carbon monoxide, a very dangerous gas indeed.

As the embers combust, each escaping carbon atom will try to combine with two oxygen atoms to form harmless carbon dioxide (CO_2).

A little carbon monoxide will always be produced regardless of the air supply, but a lot more will be produced if the air supply is cut drastically while the embers are still hot. Carbon monoxide also gets worrisome if you don't maintain a good draft up your flue. A good supply of oxygen in, and a good draft out, are essential to minimize this hazard.

The elimination of carbon monoxide (and other pollutants) sometimes becomes a special problem in very tightly-sealed homes. Natural infiltration in a drafty old house may change the inside air ten or more times in the time it takes to change the air supply once in a new, tightly-sealed house. This lack of a steady stream of fresh air may hamper both draft and combustion efficiency. One way to address the problem (without bringing back those cold breezes) is to provide an intake system that'll feed your fire with outside air instead of room air. (More about this troublesome indoor pollution problem on page 16.)

Cast Iron, Plate Steel, or Sheet Metal?

One of the first choices you'll have to make when you choose a wood stove is what metal it's to be made of. You'll probably have three choices—cast iron, plate steel, or sheet metal. All three stoves have their advantages and disadvantages.

Cast iron stoves are made by pouring molten iron into molds that correspond with different parts of the stove. After the iron solidifies, the molded parts are fitted together. Plate steel stoves consist of heavy steel plates ¼- to ½-inch thick that are cut and welded in place. Sheet metal stoves are similar to plate steel stoves in construction, although they are usually less than ⅛-inch thick, and are often bolted instead of welded together.

In general, the thicker the metal, the longer a stove will last. Both plate steel and cast iron stoves are about equal in their heat retention ability, and their purchase prices are similar. A sheet metal stove, although less expensive than plate steel or cast iron, will burn out faster and may need to be replaced sooner than the heavier-gauged types. Sheet metal stoves, as well as plate steel and cast iron models, often have firebrick or metal plates in the firebox to prevent burnout and to moderate the heat distribution of the stove.

In recent years some newer stoves have been produced using nontraditional materials, including soapstone and porcelain. Recently massive masonry stoves have become more available. All these stoves and materials are suitable if properly manufactured and installed. Many people like the look of a soapstone or porcelain finished stove, so you may want to ask your stove dealer about these options.

In most cases, the material a stove is made from is not as important as the workmanship and type of stove you buy. Seek the advice of a reputable stove dealer if you're debating what material is best for your stove.

Wood Stove Types and Overall Efficiencies

Overall wood stove efficiency is a tricky concept. It is really the sum of two kinds of efficiency: combustion efficiency and heat transfer efficiency. If you haven't got both kinds of efficiency, then you haven't got an efficient stove.

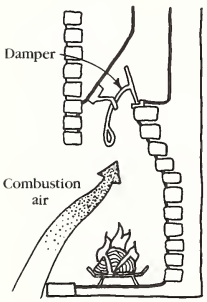
Combustion efficiency is the stove's ability to burn fuel completely and cleanly, producing the maximum amount of heat possible. Heat transfer efficiency, on the other hand, is the stove's ability to put that heat out into your room, where you want it, instead of up the flue.

The sign of high-combustion efficiency is a hot, clean, relatively smokeless fire. The sign of high-heat-transfer efficiency is a clean, hot-burning fire and a cool stack temperature. You need both.

The wood-burning devices listed below range from the least to most efficient. The percentage given for each is the percentage of the wood's potential heat actually getting out into your room.

Open Fireplace (0%-15% efficiency)

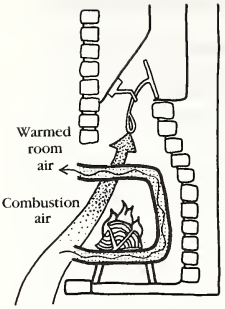
The average open fireplace is not an efficient heater. Combustion efficiency may be very high, simply because the fire can draw all the oxygen it needs from the room, but heat-transfer efficiency is usually very low. It may even be negative. More room heat is drawn out, through the flue, than is radiated by the fire because of the strong draft created and the severely limited ability of the open firebox to hold and re-radiate the heat produced into the room.



Heat-transfer efficiency can be increased a little through careful design of the firebox or by devising an intake vent that'll feed the fire with combustion air from a source other than the room you're trying to heat. But it's best to think of your open fireplace only in aesthetic terms, as a fine thing to sit next to on a cold December evening (radiant heat will keep you toasty within six feet or so), but not as an efficient way to heat your room.

Fireplace Screens, Tubular Grates (0%-30% efficiency)

A glass fireplace screen will keep sparks off your rug and decrease the amount of warmed room air that escapes up your chimney, but it'll also decrease the amount of toasty radiant heat you'll feel and may lower combustion efficiency by cutting the fire's oxygen supply, thus increasing the dangers of air pollution and creosote buildup.



A glass screen used along with an intake that draws plenty of combustion air from a source other than the space you're trying to heat will allow you to maintain a high combustion efficiency. However, to significantly increase heat transfer efficiency, you'll have to modify the firebox with tubular grates or fireplace inserts.

Some tubular grates carry room air around (or through) the firebox, where it's warmed, and then out into the room. The air is either forced through the tubes by a fan or moves through of its own accord, by convection. Tubular grates will sometimes double the heat transfer efficiency of an otherwise conventional fireplace, but it won't turn it into a stove.

For that you'll need one of the more sophisticated inserts, usually made by the same people who make stoves. These are little more than stoves redesigned to do their job in the confines of your fireplace opening instead of out in your room. They often have overall efficiencies higher than 30 percent, and are described here along with the stoves they resemble.

Stove Types

Once you're past considering fireplaces and inserts and are looking at stand-alone wood stoves, you'll need to consider two general groupings—radiants and circulators.

Radiant stoves have a single-walled firebox. These stoves heat by radiating the heat to the objects in the vicinity, such as walls, furniture, and people. Radiant heat is the type we receive from the sun. The stove heats the room by heating the material and objects in it; thus, we feel warm when in the room.

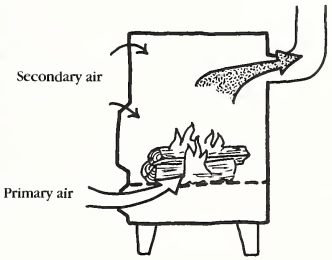
The second major type of stove, called a circulating or circulator stove, keeps you warm in a different manner. Circulating stoves have a firebox to contain the fire, and another metal layer or shield surrounding the firebox with an air space and ventilators in between. These stoves heat by circulating the air through this space, thus heating

the room and the objects in it with warm air. Circulating stoves, with their double-walled construction, can be placed at about half the distance from combustible materials required for the radiants, and, with adequate wall protection, can be located close to walls (see page 14 for more information on stove clearances).

Simple Box Stove (20%-30% efficiency)

A simple box stove is more efficient than an open fireplace, but is still the least efficient kind of stove.

This type beats the fireplace in heat-transfer efficiency since it burns fuel in a closed, free-standing metal box that radiates heat in all directions. But it falls short of more advanced stoves because the nonairtight construction won't allow you to closely control the amount of air entering. A box stove can't help but burn fast, all of the time, and takes a lot of fuel for the amount of heat it gives back. The passage of the flame, from log to flue, will be too rapid (and the distance generally too short) to allow for transfer of more than a fraction of the heat.



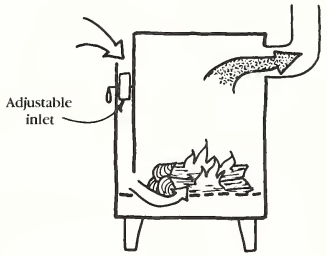
Primary air for combustion is usually admitted below the fuel through an adjustable inlet, but air is also drawn in through the numerous small openings around doors and joints.

Potbellied stoves, Franklin stoves, cook stoves, and parlor stoves often fall into this category, as do many of the less-expensive stoves and inserts on the market.

Basic Airtight Stove (40%-50% efficiency)

A basic airtight stove is more efficient than the nonairtight stove because you have more control over the amount of air entering the firebox. This lets you control the rate at which your fire burns—not so fast that it gallops through your fuel, throwing vast amounts of heat up your chimney, but not so slowly that the fire starves for lack of oxygen, throwing out equally vast amounts of air pollution and creosote.

Air for combustion is drawn in through an adjustable inlet, sometimes along a path that preheats the air by prolonged contact with hot surfaces before it reaches the fire. A little more efficiency is sometimes gained through the insertion of a baffle between the fuel and the flue. This slightly lengthens the flame path, providing more time and additional surfaces for heat transfer.

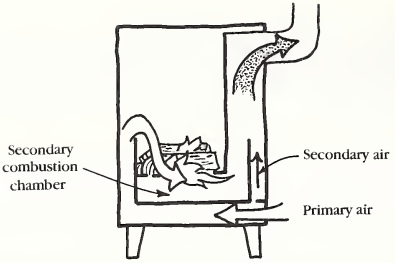


Airtight stoves are available both as free-standing models and as fireplace inserts. Because they are surrounded on three sides by the fireplace, the inserts direct all of their heat out of the front of the stove, employing well-insulated double-wall construction and the same air circulation principles used by tubular grates. They thus become convective or "circulating" heaters instead of radiant heaters. Free-standing airtights, on the other hand, radiate their heat in all directions. The overall efficiency of an airtight fireplace is similar to free-standing airtights of similar internal design.

Base-burning Airtight Stove (40%-60% efficiency)

A base-burning stove or insert adds a second combustion chamber, which allows more complete burning of secondary wood gases and vaporized liquids. This helps assure gains in both combustion efficiency and heat-transfer efficiency, as well as decreases in air pollution and creosote buildup.

Air for primary combustion is drawn in along a path that'll pre-heat it but, in this case, a little air is diverted to support secondary combustion in the second chamber.

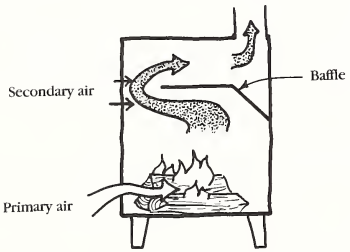


Also, the opening between chambers is at the base of the firebox, meaning that the gases and vapors must pass through the hottest part of the fire on their way to the flue, which further aids their combustion.

Front-burning Airtight "S-Flow" Stove (50%-60% efficiency)

The front-burning (or "S-flow") stove is another type of airtight stove or insert that uses a lengthened flame path and a secondary combustion chamber to increase the stove's overall efficiency.

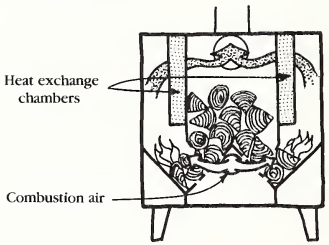
Fuel burns from the front of the firebox to the rear, with the help of primary air directed to the base of the fire. A baffle then directs the flame back to the front of the stove where it receives a charge of secondary air just before entering the secondary combustion chamber.



The "S-flow" concept has proven to be reliable and adaptable, and many of the better stoves and inserts now on the market employ some variation of it. It's a concept that lends itself well to the installation of catalytic converters (more about them later) and of windows in the door of the stove so you can watch the fire. Some serious wood burners really enjoy watching their efficient secondary-combustion chambers and catalytic converters in action. The flow of glowing super-heated gases from chamber to chamber at the front of the stove will constantly "wash" the inside of the window, preventing creosote deposit.

Downdraft Airtight Stove (50%-60% efficiency)

Though not as common as the various kinds of S-flow stoves, the downdraft stove is another efficient and relatively clean-burning device. Air for combustion is drawn in through tubes at the top of the stove in such a way as to create a draft forcing the gases produced by initial combustion downward through the coals (where secondary air is sometimes introduced), thus assuring their more complete combustion.



In some of these stoves, the wood slowly lowers into the area of combustion as it is consumed from below. And the area of combustion is sufficiently removed from the point at which fresh wood is added, that you won't necessarily cool the combustion chamber if you toss in a new load. This will help assure a clean uninterrupted burn. Every time you throw in a log or open the door of a conventional stove, the combustion chamber temperature drops as the heat moves into the room. This brief action can lower the stove's temperature so much that creosote-forming gases will not burn.

Wood-burning Furnace (up to 80% efficiency)

This is the only wood-burning device designed to heat your whole house, and like any other central heating furnace, it relies on water or forced air to distribute heat throughout the building.

Wood-burning furnaces cost more than wood stoves. Longer burns of twelve hours are typical, but a wood-burning furnace demands a lot more attention and routine maintenance than an oil or gas furnace. You still have to load it by hand, clean out the ashes from time to time, and inspect the flue for creosote. A wood furnace, in

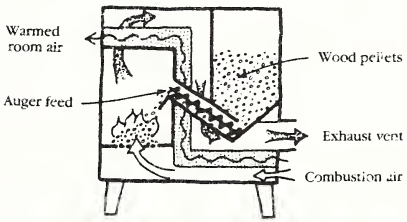
short, provides the comfort of central heating, but doesn't completely eliminate the day-to-day inconvenience of a wood stove.

Pellet-burning Stove (up to 85% efficiency)

Pellet-burning stoves represent one of the latest advances in wood fuel technology. Pellet burners burn pelletized agricultural and wood wastes that have been dried and compressed into little chunks (pellets) that look like cattle feed or rabbit food.

A pound of these pellets holds about the same number of potential Btu's as a pound of dry wood (the pellets hold between 7,000 and 9,000 Btu's per pound; a pound of wood averages 8,500 Btu's). But the pellets are much easier to handle, and they burn more cleanly and completely, leaving very little ash or airborne waste.

The nature of their fuel allows pellet burners to be designed for highly efficient heat transfer. More heat will get into your room, and less will escape unappreciated, than is the case with other wood stoves. Pellet stoves usually require simpler and less expensive ventilation systems than other wood stoves.

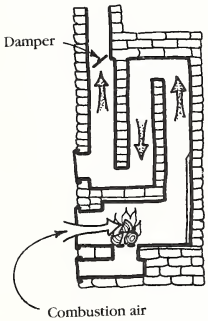


Their makers claim that pellet burners require less supervision and routine tending than wood stoves. They appear to occupy a position halfway between that of a demanding wood burner and that of a relatively carefree gas or oil furnace. You'll still have to fuel it, but less often, and you still can't afford to forget that you've got a fire going in your living room, even though it's a mild-mannered one. Pellet-burning furnaces and water heaters, which require about as much attention as the room heaters do, are also available.

Conversion kits are available to turn wood stoves into pellet-burning stoves. The availability of pellets is a potential problem. However, there are several pellet plants already operating in Montana, and their raw materials are always abundant. Note that pellet stoves usually require electricity, some manufacturers now make stoves that are battery-operated.

Russian Masonry Stove (up to 90% efficiency)

The Russian masonry stove represents one of the most efficient wood-burning devices. Efficiencies of more than 90 percent have been claimed. It's hard to compare these with other types of stoves, because there is no standard design—and because location in the house is a major heat transfer factor.



Russian masonry stoves are massive affairs that use a long, convoluted horizontal flue between the fire and the vertical flue to allow time for maximum absorption of heat by the heavy masonry, which, in turn, radiates it to the surrounding room.

A fast, hot fire, using a good charge of wood three inches in diameter or less and stacked for quick combustion, is kindled in the firebox, with the air intake wide open. When this fire has died down to coals (when blue flames can no longer be seen), both the air intake and the flue damper are closed, in effect trapping the heat inside the massive structure. As the masonry stove cools, its heat is slowly transferred to the surrounding air.

Like any other wood heater, masonry stoves have their attendant problems. The masonry must withstand enormous temperature differences and still remain airtight (the inside surface may quickly heat to 1,100°F or more, while the outside surface, a few inches away, seldom passes 140°F). A crack would be a definite fire hazard and a source of such dangerous indoor pollutants as carbon monoxide. The construction of such a device is best left to the relatively few professional masons who are up to the task. A certified chimney sweep or stove dealer will know who they are.

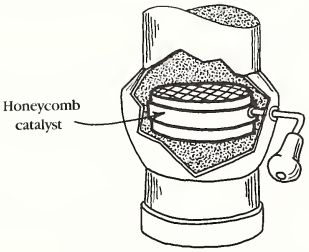
Catalytic Converters

A catalytic converter isn't a wood stove, but is used to increase the overall efficiency (up to 20 percent) of almost any wood stove it's attached to.

Catalytic converters lower the temperature at which the secondary products of combustion will ignite. Those gases and vaporized liquids otherwise escape as smoke and creosote. Ordinarily they won't ignite until they reach 1,000°F or more, but, in the presence of the catalyst in the converter, they'll ignite at 500°F-600°F.

Once ignited, the converter will reach a temperature as high as 1,500°F or more and stay hot as long as combustible smoke and oxygen pass through it, until the temperature of the entering smoke falls below 300°F or so. The catalyst consists of a thin coating of the rare metals platinum or palladium on a ceramic honeycomb structure.

A converter installed in the smoke path between fire and flue will intercept and burn much of the material that would otherwise pollute the air or condense in your flue as creosote. A small portion of resultant heat will radiate into your room. So, you'll gain in both combustion and heat transfer efficiency.

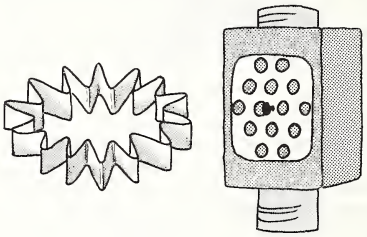


A converter is a rather fragile item, however—and those rare metals aren't cheap. You'll have to be careful not to burn anything but wood in your stove, since the lead found in nails and in the newsprint on magazines and newspapers can destroy the converter within a year.

Some stoves come with catalytic converters already installed. They're also available as retrofits that fit between your stove and your stovepipe. If they're properly installed and operated, they may last for three or more heating seasons. If your stove has a catalytic converter, have it checked regularly to make sure it's operating as efficiently as possible.

Heat Extractors

Many stove dealers sell accessories called "heat extractors" or "heat savers" that capture heat from the flue gases in your stovepipe. Heat extractors include passive devices, such as metal fins attached to the stovepipe, and active devices. An active heat extractor consists of a closed box containing hollow pipes that's inserted in your stovepipe. The flue gas from your stove flows around the pipes, warming them. This warmed air is then forced into the room by electrically powered fans.



Heat extractors do work. Typically, a heat extractor will increase the energy efficiency of your stove from 3 to 20 percent, depending on the design of the heat extractor and the efficiency of your stove. Passive heat extractors, such as the metal fins, are generally less efficient than the active, electrically powered heat extractors. In addition, the active heat extractors improve the heat distribution from your stove.

If you're considering an active heat extractor, make sure you get one that's easy to clean. The flue gases cooled by the heat extractor can quickly foul your unit if it is not cleaned properly. Many units come with a cleaning brush and clear instructions on cleaning—talk to your stove dealer, and ask him to demonstrate the cleaning process before you buy. In addition, make sure the heat extractor you're considering is approved or listed for use in your situation.

Even though heat extractors do work, there are other ways to improve your stove's efficiency. A small fan that blows air over your stove helps distribute heat, and increases your stove's efficiency by about the same amount as a heat extractor.

Economics of Wood Heating

According to a 1985 survey by Canada's energy agency (Energy, Mines and Resources), the cozy nature of wood heat and the money that wood-burners save are the primary reasons Canadians invest in wood stoves. Montanans probably invest for the same reasons. Although it's impossible to put a dollar figure on the "cozy" nature of wood heat, it's a powerful incentive for taking the plunge, and may be one of your primary considerations. We can't help you decide what that emotional appeal is worth to you—you'll have to make that decision yourself. But we can help you compare the costs of wood heating to those of conventional fuels, and see if it's economically worth it for you to convert to wood.

Keep in mind that there are three categories of cost associated with any home heating fuel: (1) the cost of the fuel, (2) the cost of the heating system, and (3) the cost of day-to-day management of the fuel and the heating system. In the first two categories, wood may be cheaper than such fuels as natural gas, oil, and electricity, but wood can be much more expensive in the management category than other fuels.

The following calculations don't take into account the time and money you'll spend cleaning your stove and chimney, watching the fuel level, or protecting your fuel supply from the weather. In the final analysis, you'll still need to make a personal decision on whether or not you want to invest your money and time in wood heating, regardless of the apparent economics.

1. How much of your traditional fuel did your home use last year?

NOTE: You can get this figure by adding up the monthly totals given on your utility bills for the past year.

2. What do you think your traditional fuel will cost next year?

NOTE: Your utility bills will show your basic gas and electric rates for the past year. You'll have to take a guess at what your future utility rates will be—no one can say for sure.

3. If you install a wood stove, how much of your traditional fuel do you still expect to use, either for supplemental heat or for uses other than space heating, such as ranges and water heaters?

NOTE: You'll still be using traditional fuels for lighting, water heating, and other uses. A good way to estimate this is to look at your summer bills to determine your base load without heating costs.

4. *What is the amount of fuel you used just for heating last year? (Subtract #3 from #1.)*

5. *What was the cost of the fuel you used for heating last year? (Multiply your answer in #4 by your per-unit energy costs in #2.)*

6. *What do you expect to pay for a cord of wood? (See page 11.)*

   NOTE: Costs in 1991 ranged from $50 to $100 per delivered cord, depending on where you live. Checking the classified section of the local newspaper would give you an idea of current wood costs in your area. If you plan to cut your own wood, costs of transportation, equipment, and your time should be considered here.

7. *How many cords will you need per year? (See page 11.)*

   NOTE: See the sidebar on comparing wood with natural gas for some ballpark figures.

8. *What will be your total yearly cost for wood? (Multiply #7 by #6.)*

9. *How much money would you save if you burned wood instead of your traditional fuel? (Subtract #8 from #5.)*

   NOTE: If your answer is negative, then wood will apparently cost you more than your traditional fuel.

10. *How much do you expect to pay for your wood stove and its installation?*

    NOTE: Consider all the costs—stove, installation, chimney, etc. Remember to subtract any state tax credits you'll get if you buy a clean burning stove that meets Montana standards.

11. *How soon would your yearly energy savings from switching to wood heat pay for the cost of buying and installing a wood stove? (Divide #10 by #9.)*

    NOTE: This is very rough estimate. Again, remember that this doesn't include the costs of chimney cleaning, hauling ashes, and the adjustments you'll have to make in your lifestyle to be a successful woodburner. If it takes longer than eight years for your wood stove to pay for itself, the savings from heating with wood are not large enough to repay a loan to buy the wood stove.

How Does Wood Compare to Natural Gas and Electricity?

- A cord of dried Montana softwood, such as pine, larch, or Douglas-fir, provides about the same amount of heat as 17.8 thousand cubic feet (MCF) or natural gas or 3,164 kilowatt hours (kwh) of electricity. If you now heat with gas, divide the number of MCF of natural gas you use for heating in a year by 17.8 to estimate the number of cords of wood you would need a year. If you heat with electricity, divide the number of kwh you use for heating in a year by 3,164 to estimate the number of cords of wood you would need a year.

  GAS: $\frac{\text{MCF per year}}{17.8}$ = cords of wood needed

  ELECTRIC: $\frac{\text{kwh per year}}{3{,}164}$ = cords of wood needed

- The "typical" Montana home uses 75 MCF of gas or 20,475 kwh of electricity a year for heating. Heating accounts for about two-thirds of your gas bills in the winter if you heat with gas or about 40 percent of your total electric bill if you heat with electricity.

- In March 1991, 75 MCF of gas from Montana Power company cost $259, while 20,475 kwh of electricity cost $1,430.

- Four and one-quarter cords of dried Montana softwood provide about the same amount of heat as 75 MCF of natural gas or 20,475 kwh of electricity.

- Four and one-quarter cords of wood bought from a dealer for $50 to $100 a cord would cost between $212 and $425.

- Therefore, your savings by switching from gas to wood in this example would be $47 a year if you got your wood for $50 a cord. But wood heat would cost $87 more a year than gas heat if you paid $80 a cord for wood. If you switched from electricity to wood, the savings would be between $1,000 and $1,218 a year, depending on the price of the wood.

What's the Real Cost of a Cord of Wood You Cut Yourself?

It may be true that it costs less to cut your own firewood than to buy it from a firewood dealer. However, there are still expenses involved in this process. If you cut your own wood, and you have to drive 25 miles to get your supply, your expenses might look something like this:

Gasoline for cutting and hauling	$12.50 a cord
Equipment depreciation (pickup truck at 30 cents a mile and chain-saw costing $200 over ten years)	$20.00 a cord
Time required to cut and handle a cord of wood (eight hours at $4.50 an hour*)	$36.00 a cord
TOTAL	$68.50 a cord

*The $4.50 an hour is an average value. If you enjoy woodcutting and consider it recreation, the cost of your time would be less than $4.50 an hour. If you have little free time and consider woodcutting drudgery, the cost of your time would be much higher than $4.50 an hour.

Chimney Fires

Chimney and wood stove fires are the biggest single cause of home fires in the nation. In Montana, there were 600 of them in 1984—that's 38 percent of the home fires reported. They're also a particularly expensive kind of fire. Insurance companies say that the average loss due to a home fire in Montana is $5,000, but that average rises to $9,000 in the case of wood stove and chimney fires.

A common misconception is that a chimney fire does some good by scouring the chimney. Don't believe it. What a blaze raging at perhaps 2,000°F will do instead is crack bricks and tiles, warp flues, loosen mortar, and destroy chimney caps. The entire chimney may have to be replaced. And, most importantly, the rest of the house and its occupants could be damaged, injured, or destroyed.

Creosote deposits over ¼" thick can ignite in the stove pipe and flue when there's a hot fire in the stove. And, creosote can accumulate amazingly fast if you keep a constant, smoldering fire. The Northwest Fire Education Consultants tell us that there have been cases of chimneys being completely blocked by creosote within three days of installation. It can also sneak up on you gradually, even if you're burning wood correctly.

You can slow down the buildup in creosote in several ways. First, burn only well-seasoned wood. Second, be sure your fire has an adequate supply of oxygen. Third, inspect your flue often. And last, clean your chimney at least once a year.

If you want this task done right, hire an expert. Because wood stoves are so popular now, your community may have a professional chimney sweep. He can do the job with a minimum of fuss and without spilling hot soot on your carpet. If you do it yourself, you will need the proper tools, including a metal brush designed for this specific job, a long, non-flammable extension rod, and other equipment. Check with your stove dealer.

You'll need to call him, or your local fire department, if you ever see a cherry-red stovepipe and hear the roar of a chimney fire. Shut off the air supply to the stove, and get everyone out of the house. Use your hose to cool the roof and shrubs, but don't spray water directly into the chimney. That could result in even more damage, by causing the overheated flue to contract too quickly.

Once the fire is out, have the chimney thoroughly cleaned and closely inspected before using it again. You might also want to buy a special chimney fire extinguisher and keep it handy.

One final safety note. A wise and inexpensive feature for any house is a smoke detector. This is especially important in a wood-heated home. Many smoke detectors can be purchased for under $50.00. A smoke detector would warn you if your stove develops a back draft during the night, or in case of fire.

Wood Stoves and Mobile Homes

Installing and operating a wood stove in a mobile home in Montana requires special vigilance. Because many mobile homes are smaller than conventional homes, they pose special problems in providing proper wood stove clearance and combustion air. If you're considering installing a wood stove in your mobile home, you'll need to be aware of strict federal guidelines. The U.S. Department of Housing and Urban Development (HUD) has issued standards that stove manufacturers must follow if they sell stoves for mobile home use. Here's a synopsis of these standards.

- The wood stove must be tagged indicating that it has met the HUD standards for use in mobile homes. Stoves meeting these standards generally have a moderate Btu output, burn only wood, and have a top-exiting flue collar.

- Clearance and installation guidelines for each type of stove must be followed. Guidelines vary depending on a stove's Btu output, so make sure you follow the instruction for your specific stove. The diagram on page 13 shows the minimum clearances and installation guidelines for placing a wood stove in a mobile home. Stoves cannot be installed in a sleeping room.

- The stove must be securely attached to the floor of the mobile home.

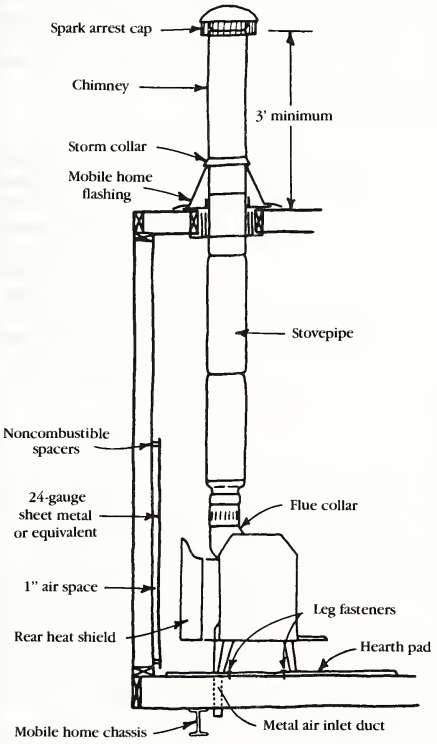
- The stove must be attached to a hard-ducted combustion air system. This duct must bring fresh air from outside directly to the air inlet on the stove.

- Only prefabricated chimneys that have been tested and approved according to the HUD standards may be used. A spark arrester cap must be attached to the top of the chimney.

- Chimneys used on mobile homes are a special area of concern. Not all chimneys for mobile homes are the same. Any chimney must be certified for use with the

wood stoves they are attached to. "There have been some problems in the past with stove owners using mismatched chimneys," says Rick Mendelen, a standards officer with HUD's Manufactured Homes and Construction Standards Division. Ask to see the product information on chimney compatability for your particular stove. In addition, you might consider purchasing one of the new high temperature chimneys that meet the stringent new standards issued by Underwriter's Laboratory (UL 103HT). Chimneys meeting this standard can withstand chimney fires up to 2,000°F. Since some new stove designs can produce hotter fires than older models, this could be a wise investment.

- Because of all the requirements for clearances, stove size, and chimney compatability, it's important that you talk to a stove dealer familiar with mobile home stove regulations before you buy.



You and Your Stove Dealer

Once you've decided that you're really ready to take on a wood stove, and once you have an idea of how a wood fire works and how the various kinds of stoves try to manage the process, you're ready to face a dealer. Select him with care.

A good dealer will be certified by WHERF (the Wood Heat Education and Research Foundation) or by WHA (the Wood Heating Association). Later you will also need to find a contractor to install the stove and a qualified chimney sweep who'll provide routine stove and flue maintenance.

Before your dealer even shows you a stove, he should ask you a lot of questions. First your dealer will try to determine how much stove you really need. He'll want to know whether you expect your stove to be a primary or secondary heat source. He'll know that most people gravitate toward stoves that are too big for them, and he'll want you to have a clear idea of what a stove will and will not do, before he sells you one.

A wood stove won't heat your whole house, for example, unless your house consists of only one room or is so open in plan that air circulates as if it were in only one room. Most wood stoves are space heaters or "room heaters." Question any dealer who claims that his are anything more.

And question any dealer who merely wants to know how many "square feet" you expect to heat. Square footage, by itself, is a meaningless figure. The distribution of those square feet, the shape of your rooms, the size of the openings between them, the height of your ceiling, the size and exposure of your windows, the type of insulation you've got—all have their effects on wood stove efficiency. A good dealer will probably ask you about all those things. If he doesn't, then you bring them up.

He may also ask you if a "heat loss calculation" was ever done for your house. In fact, one probably was, if your house is new or if you've ever bought a furnace for it. If you haven't got a heat loss calculation handy, the power company (and some stove dealers themselves) may do one for you. It might cost a little, but it'll be an invaluable aid to stove selection.

A good dealer will make sure that a stove can be installed safely in your house. He'll want to know if you

have the right sort of chimney or if you're prepared to build or buy one.

If, by the way, you plan to tap into an existing unused chimney, you might be in for all sorts of nasty surprises if you don't have it thoroughly inspected first. The Northwest Fire Education Consultants tell of a home owner who tapped into an old chimney but didn't know it had been torn down above the first floor, and no longer reached the roof, until he lit his stove for the first time and set his house on fire. Old chimneys can sometimes be used, but they often must be relined, extended, or rebuilt.

The dealer will want to know if you've got enough room to install a stove at a safe distance from combustible walls. This will help you decide on size, also. (See page 15 for information on clearances.) When in doubt about any aspect of stove safety, ask. If a good dealer can't answer your question, he'll refer you to someone who can.

After all that, you're ready to look at stoves. But remember that the error you're most likely to make is to buy a stove too big for your needs. You'll do this either because you still expect to heat your whole house or because you have an unrealistic notion of just how much heat an efficient wood stove will radiate.

Remember, a wood stove is only a space heater or a room heater. It's not a furnace. It won't heat your whole house. You can buy wood furnaces, but they're installed in the same manner as gas or oil furnaces and they cost a lot more than wood stoves.

Also, remember that it's probably better (considering fuel efficiency and the production of smoke and creosote) to have too little stove than too much. If your stove is too big for the room, you'll probably damp it down, and burn it cool and dirty, for the sake of comfort. If the stove is too small, then at least you'll burn a hot, clean fire to get the maximum amount of heat. If you buy a stove big enough to keep you snug and toasty when it's forty below with a fifty mile per hour wind outside, it'll probably be too hot the rest of the time. It's too much stove. It's best to size your stove to your average winter heat needs. A good dealer will show you how, and he might very well end up selling you less stove than you originally had in mind.

Wood Stove Clearances

Properly installing a wood stove can be a hassle. You need to provide adequate clearance on all sides, use fireproof material underneath and around the stove, and pay close attention to chimney installation. But it's of the utmost importance to do the job right. Even though it may be difficult to install a stove where it's convenient, aesthetically pleasing, and at the same time safe, don't compromise. Your first priority is safety.

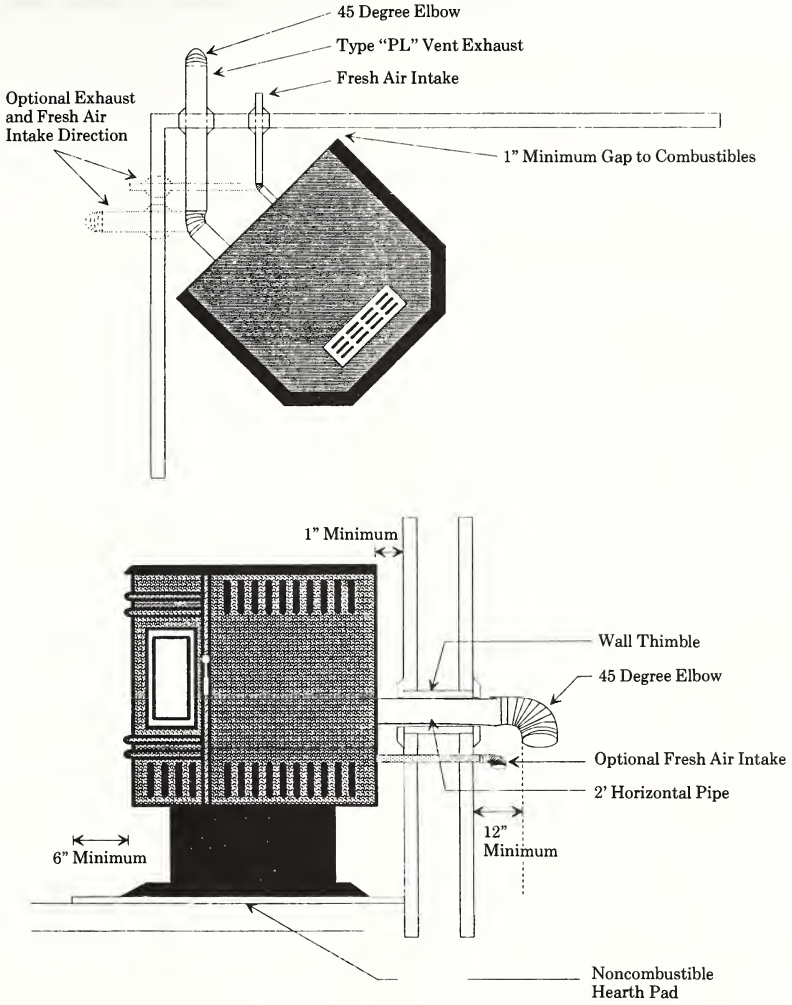
House fires may occur if your stove has insufficient clearance from combustible walls, floors, and ceilings. The stove's radiated heat may catch these objects on fire. Another, less noticeable process can also start house fires. Over several months, objects exposed to low-temperature heat can form combustible gases and tars. Eventually, these objects may ignite, even if they're only heated to 250°F. So make sure that your stove clearances are adequate.

Different types of stoves may require different clearances. Each stove must be installed according to the manufacturer's instructions and in accordance with its listing. For unlisted stoves, contact your local Building Codes Department or fire official.

For example, circulating stoves are surrounded by an outergrilled jacket that allows air to circulate, drawing heat away from the stove. This allows smaller clearances than those recommended for radiant wood stoves. In addition, some new models of pellet-burning stoves are so efficient that they can be vented in a manner similar to a gas heater. Talk to your stove dealer and check the manufacturer's information for specific stoves' recommended clearances. Finally, check with local building code officials or your fire marshall for installation recommendations and information on what, if any, permits you might need.

Should you notify your insurance company that you intend to install a wood stove? Definitely. Many insurance companies require policyholders to let them know if they make major changes to a house that could affect its safety—this may include installing wood stoves. Some companies insist that your wood stove be installed according to certain safety standards. Failure to notify your insurance company that you've installed a wood stove might cause problems with payment of a claim if you have a house fire started by your stove. So contact your insurance representative, both for safety's sake and to keep your policy in force.

Installing Your Pellet Stove



Reprinted with permission from the May 1991 "Owner's Manual and Operating Instructions" for the Whitfield Advantage II-T Pellet Stove manufactured by Pyro Industries of Everett, Washington. Each wood stove should be installed according to the manufacturer's instructions for that model and its listing by an independent testing laboratory. If you have an unlisted stove, contact your local Building Codes Department or fire official before installing your stove.

Figure 1

Wood Stoves and Air Pollution

Wood fires produce dozens of different gases, particulates, and other airborne odds and ends. Many of these substances, if inhaled often enough, will threaten your health. Wood smoke contains dozens of chemicals, such as benzopyrene, toulene, and xylene. Some of these chemicals merely are irritating, but some can be quite dangerous, even carcinogenic.

Indoor and outdoor air pollution is the biggest health problem associated with wood burning. But what, exactly, do those pollutants do to you?

The particles that comprise wood smoke are "highly respirable," meaning that they're small enough to dodge your body's natural defenses and reach deep into your lungs, where they'll accumulate. Once there, these particles can hurt you in three ways.

First, simply by accumulating, they'll irritate your lungs. This can aggravate asthma, bronchitis, and other respiratory diseases. Even if you don't have respiratory problems, the particles may make you cough, or give you a sore throat, a runny nose, headache, or nausea. They may decrease lung performance, decrease your body's resistance to viruses and bacteria, increase chest discomfort, and may even put an additional strain on your heart. So, if you have a chronic heart or lung problem of any sort, it might be best not to heat your house with wood.

Second, in addition to being irritants, the particles and gases in wood smoke are sometimes carcinogenic or downright poisonous, all by themselves. Carbon monoxide, for example, can quickly kill you by reducing your blood's ability to carry oxygen throughout your body. The carcinogens will take much longer to do their damage, but the consequences may be just as dire. Think of cigarettes—cigarette smoke and wood smoke are identical in many ways.

Third, airborne particles, which may be irritants or toxins themselves, also provide a means of entry for smaller particles that adhere to their surfaces. Among these carrier pollutants are a lot of complex hydrocarbons that are small enough to easily enter your bloodstream by way of your lungs. Some of these are known to threaten your health, and many more are strongly suspect.

A hot, clean fire will produce far fewer pollutants than will a smoky, damped-down fire. But even the cleanest fire will produce some pollution, and every wood stove (even the airtights) will let some pollutants escape into your house.

Indoor air pollution from wood stoves isn't a serious problem when a good stove is used correctly in many Montana homes, because most homes are just leaky enough to assure a good, fresh draft for the stove. With a good draft, air pollutants go up the flue. With a frequent exchange of room air the pollutants that leak from the stove can't stay around long enough to concentrate in the room air.

However, indoor air pollutants can get to be a problem as you tighten your house against air infiltration. As less outside air gets into your house, room air is exchanged less often, and indoor pollutants may have time to accumulate.

The problem is especially evident in the kitchen, where cooking odors will linger all day unless you install a fan and vent system to move the stale air out and bring some fresh air in. You'll have the same problem in the room where you keep your stove, though it may be far less evident because some of the pollutants (notably carbon monoxide) are odorless.

So, if you seal your house tightly enough to significantly reduce air infiltration (and that, after all, is the point of sealing your house), and if you still intend to burn wood, consider doing the following.

1. Provide a system to vent and renew the air in the room where you keep your stove. Treat that room as if it were your kitchen, full of cooking odors that you want to get rid of. You might consider using an air-to-air heat exchanger to retain room heat while providing ventilation for the room.

2. Provide an air intake system that will feed your fire with outside air instead of room air. This can assure a flue draft adequate to vent many of the pollutants coming from your fire, even in the tightest house, and, since oxygen feeding the fire is drawn from outside rather than from your heated room air, it'll save heat.

3. Always burn a hot, clean fire. This will minimize the amount of indoor pollutants produced in the first place.

Besides indoor air pollution problems, wood stoves are responsible for an increasing amount of outdoor air pollu-

tion in Montana. Every winter we read of reduced visibility and the smoky air in communities in the western part of our state, especially in Helena and Missoula. On cold, still days, wood smoke is trapped and concentrated during winter temperature inversions, creating an increasing problem. Air pollution from wood smoke is not limited to Missoula and Helena—smaller towns, such as Libby, Thompson Falls, Ronan, Polson, and St. Ignatius, as well as Bozeman and possibly Kalispell, also suffer from occasional winter air pollution that may be caused in part by wood smoke.

Some Montana communities are taking action to attempt to control air pollution from wood smoke. Missoula, for example, has had burning restrictions in place since 1983. Helena has also passed its own burning restrictions, which went into effect in early 1986. Butte and Libby recently began wood burning curtailment programs. Daily air quality reports are given through the media, and, when air pollution is expected to stay at a high level for an extended time, wood burning can be restricted. There are certain exemptions to the burning restrictions, and each community has different rules. You should contact your health department for details.

Even though burning bans may help reduce pollution from wood stoves, a better long-term solution may be to require new wood-burning appliances to operate more efficiently so that they emit less pollution. Since July 1, 1990, the Environmental Protection Agency (EPA) has required all new wood stoves to meet strict emission standards.

The State of Montana offers a tax credit for people who choose cleaner-burning new stoves. Non-catalytic stoves that emit less than 4.1 grams per hour when tested in accordance with EPA methods are eligible for a state income tax credit equal to 10 percent of the first $1,000 of the purchase price and five percent of the next $3,000. The income tax credit for pellet-burning stoves that emit less than 4.1 grams per hour or are exempt under EPA's air-to-fuel ratio is 20 percent of the first $1,000 of the purchase price and 10 percent of the next $3,000. This means you would receive a $250 income tax credit if you bought a $1,500 pellet stove or a $125 credit if you bought a $1,500 non-catalytic stove that emits less than 4.1 grams per hour.

Not all brands meet the strict guidelines required for the tax credit. For a list of the stoves that currently qualify for the tax credit, contact the Air Quality Bureau of the Montana Department of Health and Environmental Sciences, Cogswell Building, Helena, MT 59620; phone 444-3454.

Where to Find Your Fuel

The Montana woods are always owned by somebody—a rancher, a suburbanite, a corporation, a government agency, or the public. You'll need permission to cut firewood anywhere outside your own property.

The U.S. Forest Service and the Bureau of Land Management (BLM) look after most of the public woods in Montana, but these agencies will readily grant you a permit to cut wood. BLM charges $10 for five cords. The Forest Service charges $5 a cord with a two-cord minimum. Check with the nearest BLM or Forest Service office for details.

The State of Montana, through any field office of the Department of State Lands, sells permits for cutting wood good only on the land managed by that department. State lands are spread from one end of the state to the other, and are often poorly marked in the field or nearly inaccessible. Be sure you know exactly where the wood is before asking for a state permit to cut it, and be sure to get the permission of any private landowner whose land you must cross to reach it.

If your potential wood supply is on private land, then the permission of the owner is essential *before* you get out your chain saw. Many ranchers and other landowners who'd readily grant permission if asked, will become very angry indeed (justifiably so) if you enter and cut without permission. That's trespassing and theft and is against the law. If you can't reach the owner, forget the wood.

Large corporate landowners, such as Champion International and Burlington Northern (BN), offer pay permits similar to those offered by the Forest Service. BN offers permits to senior citizens. There will be a strict set of guidelines you must follow in the field, but the wood will be worth the effort. These permits are usually available at any of the corporations' offices.

How to Recognize Montana's Best Firewood Trees

Eighty percent of Montana's forests lie in the western third of the state. Most of the trees are conifers, with their roots in the rocky, acid soils of the mountains or the benches and uplands of the eastern two-thirds of the state. Wherever they grow, the first trees above the grasslands are usually ponderosa pine. Douglas-fir grows well in moist areas, and, in those places that receive even more moisture, grand fir, juniper, western hemlock, and spruce are found. Below timberline, dryer slopes have subalpine fir, mountain hemlock, whitebark pine, and alpine larch; along the rivers, cottonwoods grow in groves.

The kind of tree you cut for firewood is important, because each type varies in the amount of heat it can provide to you. Some have an unpleasant smell when burning; others may be heavy to haul, difficult to split, or contain a lot of resin, which contributes to air pollution.

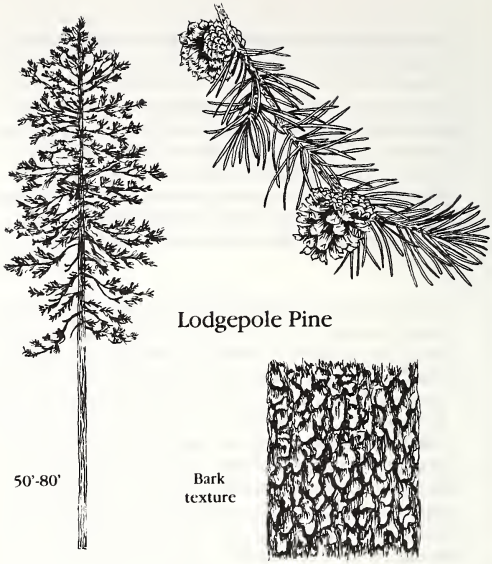
Table 1 presents some information on the kinds of trees you may find. Your best choices, though, are lodgepole pine, western larch, and Douglas-fir, because of their extensive distribution and their quality as firewood. The following descriptions will help you identify them.

Whenever possible, cut only dead trees for fuel. The live ones will be harder to handle, they'll require more drying (seasoning) time, and they have a living biologic and aesthetic role to play that outweighs their fuel value. Learn to recognize them both dead and alive, because you'll find both together.

Lodgepole Pine

Lodgepole pine is a forest tree, almost always found in dense, pure stands where it grows straight and slender with a narrow crown of short irregular branches. The bark is very thin, even on the oldest trees, scaly purplish or brownish gray in color. The needles are yellowish green, about two inches in length, and grow in clusters of two. The cones are small (less than two inches long), rounded, and often stay on the branches for many years. Even after the tree has died, the attached cones are a sure means of identification.

Lodgepole pine is a relatively small tree, seldom more than a foot in diameter at the base. In dense "doghair" stands, where the trees stand only a few feet apart, pines a



hundred years old may be only a few inches in diameter and less than forty feet tall. Many will be standing dead and will make fine firewood, as will the fresh windfall that often litters the floor of these stands.

Look for lodgepole pine at middle elevation, up to timberline, on the cooler north and east slopes and upland flats. It's usually easily accessible from forest roads.

Western Larch (sometimes called tamarack)

The larches are the only needle-leaf trees in Montana that change color in the fall (to a rich, golden yellow) and shed their needles for the winter. Identification is no problem in October.

In summer those needles are a soft green, about an inch long, growing in tufts at the ends of short, bumpy spurs that line the branches. In winter the spurs remain and are a good clue to identification.

Western larch is a forest tree with a fondness for rich, moist soil. It seldom forms pure stands in Montana but often grows in association with pines, Douglas-fir, and other conifers. It grows tall and ramrod straight with a rather densely branched, pyramidic crown, where the small cones are visible after the needles have fallen.

The bark is distinctive, gray to cinnamon brown, and scaly on young trees but becomes thick and deeply furrowed on older ones. And they can get very old indeed: 500 to 700 years or even older. The big, broken-top snags left when these old-timers die are very important to wildlife (dozens of species of mammals and birds call them home) and should not be cut for firewood.

Nor should you cut a smaller cousin of the western larch, called alpine larch, a timberline tree with a more chunky and irregular growth form, that is scarce in Montana. Alpine larch, luckily, is usually inaccessible, but western larch is relatively plentiful and easily reached from forest roads in that part of Montana north and west of Missoula.

Bark texture

Western Larch

100'-150'

Try to cut larch in the summer, to be sure of getting dead, dry wood. If you must cut in the winter, avoid a tree whose small branches are still intact and whose bark appears sound and unbroken. It's probably alive.

Douglas-fir

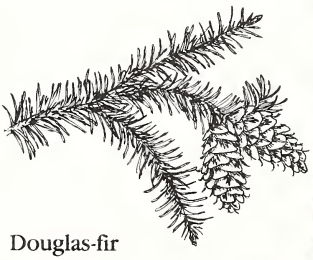
Next to ponderosa pine, Douglas-fir is the most widely distributed conifer in Montana. It's the one that most of us use for Christmas trees. This familiar tree (not a fir at all, but in a genus all its own) grows all the way from fairly dry mountain ranges, such as the Bearpaws and the Belts, often in extensively pure stands, to such relatively moist ranges as the Cabinets and Bitterroots, where it associates with several other conifers. Douglas-fir grows from the edge of the prairie and the river bottom, high into the mountains, though not to timberline. In the middle elevations it often dominates the landscape.

Douglas-fir needles are short, an inch or so long, and radiate in all directions from the twig, which usually ends in a pointed bud. They're a dark, cool green with a white stripe.

The cones average about two inches in length, and can be distinguished by their three-pronged bracts between the scales. The bract looks like a chipmunk diving under a shingle—keep that image in mind, and you'll always know a Douglas-fir cone at a glance. The bark on young trees is smooth and silvery, with an occasional resin blister, but becomes dark, corky, and deeply furrowed on older trees. It may appear almost black when wet with rain.

Douglas-fir can grow to be quite large, with a spreading, irregular crown. Ancient, gnarled individuals are often found at the edge of ridgetop meadows, but these overgrown giants, alive or dead, should not be cut for firewood. They're essential to wildlife and to the landscape.

Cut Douglas-fir in relatively dense, pure stands, where you'll usually find standing dead trees of a manageable diameter and plenty of fresh deadfall.



Douglas-fir

Bark texture

100'-200'

Table 1. How to Identify Trees for Firewood

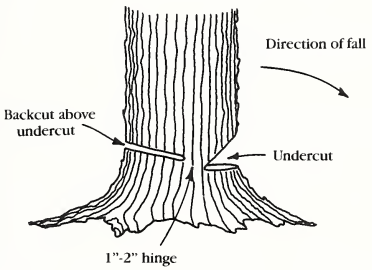
Species	Heat Value	Comments
LODGEPOLE PINE	Medium	Lodgepole is your best choice in much of Montana. It burns relatively cleanly and completely, leaving little ash. It's easy to handle, and is often very plentiful as deadfall or standing dead timber of relatively small diameter.
LARCH	High	Cut larch in the summer. It sheds its needles in the fall and may appear dead during the winter to inexperienced cutters. Don't cut big old snags with broken tops and holes in the trunk. These provide very important habitat for wildlife. Larch is not found in most of Montana.
DOUGLAS-FIR	Medium	Plentiful in much of Montana where larch is not found, and often more accessible than lodgepole. Don't cut large snags with woodpecker holes, or lone snags on the edge of their range or on the edge of mountain meadows. These are used extensively by wildlife.
PONDEROSA PINE	Low-Medium	Ponderosa pine are often more easily accessible than other trees and are thus over-used for firewood in Montana. The wood has a lot of resin, which makes it fine for crackly camp fires but not so for stoves. The resin and substances in the bark produce more than the average share of air pollution and creosote. Don't cut gnarled old snags; wildlife (and the landscape) need them. Ponderosa pine is Montana's state tree.
SPRUCE	Low	The wood is very light, when dry, but low in heat potential. Spruce often grows along streams and in other moist places where it should be left alone. Better firewood choices are always available in spruce country.
WILLOWS, COTTONWOODS, POPLARS	Low	These closely-related trees have wood that is very light and easy to handle, but it's low in heating potential and sometimes has an unpleasant odor when burning. These trees love wet ground and are often very important for stream retention. They also provide wildlife habitat in otherwise treeless areas.
OTHER SOFTWOODS	Variable	Juniper, cedar, subalpine fir and other firs, limber pine, whitebark pine, white pine, alpine larch. As a rule of thumb, leave them alone! They are often scarce, or inaccessible, or they constitute the only tree on marginal sites, places that are too high or too dry for other conifers. They're very important where they are, and better choices are usually nearby.
HARDWOODS	Variable	Montana has few native hardwoods, and those we have seldom get big enough or plentiful enough to provide much firewood. But, hardwoods are planted extensively in our cities. When these are cut because of storm damage, disease, or land redevelopment, they can provide high-quality firewood. Ask your local parks department. For the sake of our urban quality of life, however, don't get in the habit of looking upon our urban trees as a potential fuel source.

Cutting Your Fuel

There are a multitude of hazards associated with wood cutting, particularly if you use a chain saw, but even if you're one of those hardy souls who attacks the job with a bucksaw or a "Swede saw." You can minimize many of these hazards (you can never completely eliminate them) if you keep the following rules in mind.

When cutting a standing dead tree:

- Determine the direction the tree is most likely to fall, make absolutely sure that it has an obstacle-free path all the way to the ground, and notch the trunk (see the illustration) to ensure that it will indeed fall that way. Don't expect a notch to redirect a leaner, however. If the tree leans east, it'll fall east, no matter how deeply you notch the west side. That sounds obvious, but even trained foresters have been known to overestimate the power of a notch. Study the tree for awhile, find its center of gravity, and then apply a little common sense.



- Make sure you've got room to get out of the way once the tree begins to tip, and that you've got an alternative escape route in case it tips where it's not supposed to. Also make sure that the tree has no large, partially detached branches or a rotten top that'll vibrate loose and fall on you as you cut it. These "widow-makers" are notorious among loggers, and are aptly named.

- Don't cut on windy days. Common sense will tell you why.

- Don't cut trees adjacent to roads, campgrounds, recreation sites, lakes, or streams, or trees that are obviously used by wildlife. Leave as short a stump as possible. Clean up your slash; keep it out of streams or ponds.

When using a chain saw:

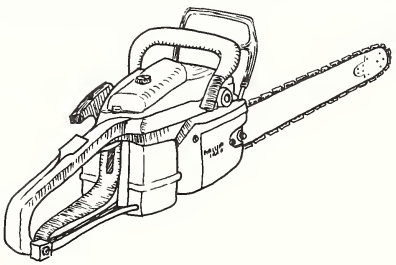
- Know everything in the owner's manual, and follow it to the letter. Keep the chain sharp and under proper tension; keep the idle speed in proper adjustment. (The chain should never move while the engine idles. If it does, don't use the saw until it's been repaired.) Keep the whole machine free of dirt, spilled fuel, and sawdust. Shut off the engine and be sure the chain has stopped completely before trying to adjust it.

- Protect yourself. Wear a hard hat, safety glasses of some sort, gloves, safety boots, hearing protectors, and clothes that fit trimly enough that there are no loose flaps to get caught in the chain. Rest when you get tired. Stop cutting if the wind picks up or the sun sets, and never work alone. If you're hurt, somebody's got to get you out of the woods.

- Respect your saw. Never rest it or start it on your knee. Always hold it with both hands by the handles provided. Start your cut at full throttle, continue it at full throttle, and be sure that no part of your body (or anything else you don't want cut) is in the path that the saw will follow when the log's been cut through. Avoid "kickback"; keep your work area free of small branches, rocks, and other odds and ends, and don't run the chain into the ground.

- Respect the wood you're cutting. Keep yourself, your saw, and your fuel out of the way of the falling tree, and stand on the uphill side of the downed log you're working on, in case it rolls when cut through.

- Carry the saw correctly, the engine stopped, the guide bar pointed behind you and covered with the guide bar sheath, and don't let the hot muffler touch your body, your clothing, or anything else you don't want to burn (the woods, for example. Be particularly careful if the weather is hot and dry late in the season). Don't store your saw near an open flame.

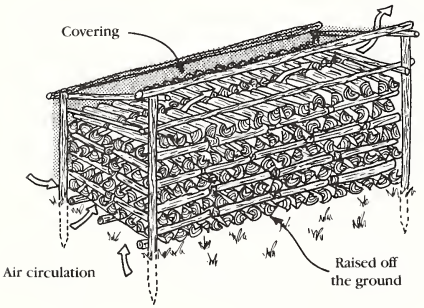


Proper Fuel Storage

The benefits of selecting the right kind of wood and cutting early will be lost unless your wood is stored properly. Improper storage may even increase moisture content. Lower moisture content means you will burn less wood to get the same amount of heat. It also means less creosote and a reduced risk of chimney fires, and you will be creating less air pollution. There are four important steps to proper wood storage.

1. **Split your wood before stacking.** This increases the exposed surface area and reduces drying time.

2. **Stack your wood in alternate directions.** This spacing allows for greater air circulation and further reduces moisture content.



3. **Store your wood off the ground.** Wood should be stored at least 6 inches off the ground to protect the lower part of the woodpile from ground moisture.

4. **Protect your wood from rain and snow.** The best method of storage is a woodshed. People often store their wood against the side of the house or under trees in the yard. Neither of these methods adequately protects the wood.

If You're Still Thinking of Wood Heat

Heating with wood demands your labor, time, and constant attention. You'll have to gather the wood or purchase wood pellets, tend the fire, remove ashes, and clean the chimney. You'll also be exposing yourself and your family to possible dangers, ranging from minor burns to chimney or house fires. You may be breathing irritating gases and particles, while adding to pollution problems outside. And, in certain areas of Montana, you may not be allowed to burn when you want to if the air quality happens to be poor that day.

Even with these problems, you may find that wood heating is for you, and that the satisfaction you get from heating with wood is worth the effort. A well-constructed stove, carefully installed and properly operated, will overcome many of the problems mentioned above. It may also reduce your utility bill, and may even enhance the market value of your home. Wood heating is reliable, and is unaffected by downed power lines or blocked fuel deliveries. And the cozy atmosphere created by a wood stove on a cold winter day is hard to beat.

You may find, however, that wood heating isn't for you. Patrick McCahon, wise in the ways of wood stoves and a thoroughly trained airport fireman by profession, returned to heating with gas after five years of wood heat. Not that his stove wasn't a clean and efficient heater. It was. And not that he wasn't able to adapt his life to meet its demands. He was (and he plans to keep right on cutting a little wood for his friends just for the fun of it). McCahon simply felt that, after five years of weighing the benefits of wood heating against its costs, it wasn't for him. McCahon, as well as other Montanans, has learned that wood heating is not a panacea, or symbolic "Declaration of Independence" from his local power company, or a romantic return to pioneer self-reliance. Wood heat is simply one heating option among many, costing, in one way or another, about as much as any other option.

It's your decision.

Other Reading

Magazines

"Buyer's Guide to Clean Burning Wood Stoves."*New Shelter.* Emmaus, Pennsylvania. October 1984.

"Cleaning Up Wood Heat." *Mother Earth News.* Hendersonville, North Carolina. September/October 1982.

"High-Efficiency Wood Stoves." *Consumer Reports.* Mount Vernon, New York. October 1985.

"How Well Do Catalytic Combusters Work?" *Organic Gardening.* Emmaus, Pennsylvania. October 1982.

"Is Wood Heat For You?" *New Shelter.* Emmaus, Pennsylvania. October 1984.

"Lessons Learned in Oregon." *Wood'n Energy.* Laconia, New Hampshire. July 1985.

"The Pollution Problem in Your Living Room." *Montana Magazine.* Helena, Montana. January/February 1981.

"Ready for a Wood Stove? Here is How to Decide." *Sunset.* Menlo Park, California. November 1984.

"Safety Tips for Woodburners." *Better Homes and Gardens.* Des Moines, Iowa. January 1985.

"Ten Wood Stoves Have Made The Grade." *Mother Earth News.* Hendersonville, North Carolina. September/October 1985.

"When Does it Pay to Burn Wood?" *Organic Gardening.* Emmaus, Pennsylvania. September 1982.

"Wood Stoves and Mobile Home Safety." *Mother Earth News.* Hendersonville, North Carolina. September/October 1985.

Books

Bartok, John W. **Solid-Fuel Furnaces & Boilers.** Charlotte, Vermont: Garden Way Publishing, 1982.

Curtis, Christopher, and Post, Donald. **Be Your Own Chimney Sweep.** Charlotte, Vermont: Garden Way Publishing, 1978.

Great Lakes Regional Biomass Energy Program. **Wood Heating Handbook: A Practical Guide for the Residential User.** Madison, Wisconsin: 1985.

Montana State University. Cooperative Extension Service. **Auxiliary Heating Systems: Installation, Maintenance.** Bulletin 1197, Revised. Bozeman, Montana: 1982.

Newcomb, Wilburn W. **Wood Stove Handbook.** Indianapolis, Indiana: Howard W. Sams & Co., Inc., 1978.

Shelton, Jay. **The Woodburner's Encyclopedia.** Waitsfield, Vermont: Vermont Crossroads Press, Inc., 1976.

Who to Contact for More Information

Montana Department of Administration
Building Codes Division
1218 East Sixth Avenue
Helena, MT 59620
(406) 444-3933
(Information on clearances, code requirements for installation of wood-heating equipment.)

Montana Department of Health and Environmental Sciences
Air Quality Bureau
Cogswell Building
Helena, MT 59620
(406) 444-3454
(Information on Montana's wood stove tax credit, air pollution regulations in various communities.)

Montana Department of Justice
Fire Marshall Bureau
Scott Hart Building
3030 Roberts
Helena, MT 59620
(406) 444-3933
(Information on fire codes, fire safety.)

National Fire Protection Association
Batterymarch Park
Quincy, Massachusetts 02269
(800) 428-1718
(Free technical assistance on any questions about energy conservation and renewable energy, including wood heat safety and installation guidelines.)

Montana Department of Natural Resources and Conservation
Energy Division
1520 East Sixth Avenue
Helena, MT 59620-2301
(406) 444-6697
(Information on all aspects of wood heating.)

Check with your local city or county health department for more information. Several Montana communities have air quality offices, 24-hour air pollution reports, and free information on wood burning.

Energy Division
Department of Natural Resources and Conservation
1520 East Sixth
Helena, MT 59620-2301
(406) 444-6697

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